DOCUMENT RESUME

ED 470 972 TM 034 600

AUTHOR Howard, Bruce C.; McGee, Steven; Hong, Namsoo S.; Shia, Regina

TITLE The Influence of Metacognitive Self-Regulation on Problem-Solving in Computer-Based Science Inquiry.

PUB DATE 2000-04-00

NOTE 10p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 24-28, 2000).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS Computer Assisted Instruction; *Elementary School Students; Elementary Secondary Education; *Metacognition; *Problem Solving; *Science Instruction; *Secondary School Students; Self Evaluation (Individuals)

IDENTIFIERS Self Monitoring; *Self Regulated Learning

ABSTRACT

This study was conducted to examine particular metacognitive monitoring and regulatory skills (Knowledge of Cognition, Objectivity, Problem Representation, Subtask Monitoring, and Evaluation) in the context of solving science problems within a computer-based learning environment. The study also attempted to replicate the results of H. Swanson's (1990) study, which examined the interactions between problem-solving outcomes for students categorized according to high and low levels of metacognition and high and low levels of aptitude. Participants were 1,163 students in grades 5 through 12 from schools across the United States. Overall, the total score for metacognitive monitoring and regulatory skills was a significant predictor of both Content Understanding and Problem Solving, Three of the five factors (Knowledge of Cognition, Objectivity, and Problem Representation) were significant predictors of Content Understanding. Four of the five factors (Knowledge of Cognition, Objectivity, Problem Representation, and Evaluation) were significant predictors of problem solving. Results also show that those with high Metacognitive Self-Regulation compensated for low aptitude on both Content Understanding and Problem Solving measures. Implications for instruction and research are discussed. The instrument is attached. (Contains 6 tables and 20 references.) (SLD)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 470 972

American Educational Research Association 2000,
New Orleans: Poster Session

The Influence of Metacognitive Self-Regulation on Problem-Solving in Computer-Based Science Inquiry

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

B. Howard

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Bruce C. Howard[1], Steven McGee,
Namsoo S. Hong, Regina Shia

NASA Classroom of the Future™
at Wheeling Jesuit University

Abstract

Research from several quarters has shown that metacognitive monitoring and control are important skills for successful problem solving (e.g., Artzt & Armour-Thomas 1992; Carr & Jessup, 1997; Hmelo & Cote, 1996; Tobias & Everson, 1995). In particular, research has demonstrated that self-regulation and use of metacognitive skills predicts problem solving success as well as or better than traditional predictors of general ability such as achievement scores (Swanson, 1990).

The purpose of this research study was to examine particular metacognitive monitoring and regulatory skills (Knowledge of Cognition, Objectivity, Problem Representation, Subtask Monitoring, and Evaluation) in the context of solving science problems within a computer-based learning environment. We also sought to replicate the results of Swanson's (1990) study, which examined the interactions between problem solving outcomes for students categorized according to high and low levels of metacognition and high and low levels of aptitude.

Overall, the total score for metacognitive monitoring and regulatory skills was a significant predictor of both Content Understanding and Problem Solving. Three of the five factors (Knowledge Of Cognition, Objectivity, & Problem Representation) were significant predictors of Content Understanding. In addition, four of five factors (Knowledge Of Cognition, Objectivity, Problem Representation, & Evaluation) were significant predictors of Problem Solving. Results also showed that those with High Metacognitive Self-Regulation compensated for Low Aptitude on both Content Understanding and Problem Solving measures.

These results have several implications for researchers and classroom educators alike. Most researchers in the learning sciences agree that metacognition and self-regulation are important predictors of student success in school. The research briefly presented here helps to justify such claims by demonstrating that particular metacognitive self-regulation variables are important for success in both content understanding and problem solving. It is our hope that such research will eventually lead to the development of a model for problem-solving activities and materials that would foster metacognitive self-regulation.

Background

Metacognitive Self-Regulation

Various definitions and models of self-regulated learning abound in the research literature (Bruning, Schraw and Ronning, 1995). Zimmerman (1989) captured the sweeping purview of self-regulated learning when he said, "Students can be described as self-regulated to

[1] Contact: Bruce Howard or Steven McGee, 316 Washington Avenue, Wheeling, WV 26003, (304) 243-2388, howard@cet.edu, mcgee@cet.edu

TM034600

BEST COPY AVAILABLE

the degree that they are metacognitively, motivationally, and behaviorally active participants in their own learning process" (p.4).

For this study, we concentrated on what it means to be a "metacognitively active participant" in the process of scientific problem solving. In particular, we examined five facets of metacognitive self-regulation:

- Knowledge of Cognition: understanding the extent and utilization of one's unique cognitive abilities and the ways one learns best.
- Objectivity: standing outside oneself and thinking about one's learning as it proceeds.
- Problem Representation: understanding the problem fully before proceeding.
- Subtask Monitoring: breaking the problem down into subtasks and monitoring the completion of each subtask.
- Evaluation: double-checking throughout the entire problem-solving process to evaluate if it is being done correctly.

Metacognition and Problem Solving

In 1990 H. Lee Swanson presented a pivotal work linking metacognition to successful problem solving. Swanson set out to demonstrate the independence of metacognition and general aptitude on various problem-solving measures. He measured aptitude with standardized, cognitive ability and achievement tests. He measured metacognitive ability using tape-recorded responses to a metacognitive questionnaire. His findings indicated that metacognition was more important for problem-solving success than aptitude and that in situations where students had low aptitudes but high metacognition, they performed as well as students who had high aptitude. The implications of this finding are numerous given the strong emphasis placed on aptitude by educators throughout the history of psychological measurement.

We believe the implications of Swanson's research are especially pertinent to science education with its emphasis on problem solving. Some could argue that aptitude is innate and, therefore, largely unchangeable through instructional interventions. Like aptitude, metacognition may also be innate. Unlike aptitude, however, many would argue that metacognition may be more susceptible to change. That is, at the very least, regulatory behaviors such as goal-setting and selection of learning strategies, can be taught. If these can be taught, this gives promise to the notion that students of low aptitude may be taught strategies and behaviors that would lead to success at problem solving comparable to students of higher aptitude.

Recent research has demonstrated similar findings. At the University of California at Berkeley in a project for physics education, White and Frederiksen (1998) demonstrated that teaching students monitoring behaviors (to promote metacognition) improved student performance significantly. In particular, their results revealed that low-achieving students demonstrated outcomes similar to those who were typically higher achieving. Thus, the model treatment helped to reduce the educational disadvantage that low-achieving students often face and provided for greater equity across all students.

In addition, research in science education is indicating that a variety of regulatory behaviors may be learned and that such behaviors are beneficial for learning. For example, research has shown that certain behaviors lead to success in science education, such as identifying goals (Linn 1995), self-assessing (White & Frederiksen, 1995), planning (King, 1988; Scardamalia & Bereiter, 1991), self-explaining (Chi, Bassok, Lewis, Reimann, & Glaser 1989), self-questioning (King 1994), reflecting (Davis, 1998; Audet, Hickman & Dobrynina, 1996), and making concepts personally relevant (Linn, 1995). In addition, in numerous studies concerned with training students to use cognitive strategies, Pressley and colleagues have found

BEST COPY AVAILABLE

their instructional method to have significant benefits in the area of reading comprehension (e.g. Pressley, Schuder, Bergman, & El-Dinary, 1992).

Our own research in testing educational theory in actual classrooms has revealed implications for strategies to promote metacognition. For example, research using the CET-developed CD-ROM *Astronomy Village®: Investigating the Universe* provided the first evidence that students may not necessarily need nor use high levels of metacognition to solve every type of problem (Hong, 1998). This research indicated that metacognitive awareness was a significant predictor of success for ill-structured problem solving, but was not significant for solving well-structured problems.

Research Questions

In this study, we sought to investigate which components of metacognitive self-regulation are most important for scientific problem solving. We hypothesized that five facets of metacognitive self-regulation, as measured by the Inventory of Metacognitive Self-Regulation (Howard, McGee & Shia 1999), would predict success at problem solving. By examining the facets, we hoped to create a descriptive profile of the components of metacognitive self-regulation that are most important for problem solving. Further, we sought to replicate the results of Swanson's (1990) study which examined the interactions between problem solving outcomes for students categorized according to high and low levels of metacognition and high and low levels of aptitude. We predicted that the results would be congruent, that is, that high levels of metacognitive self-regulation could compensate for low overall aptitude.

Method

Participants

Participants included 1163 students, grades 5–12 from schools across the U.S. representing a cross-section of socioeconomic backgrounds and urban/suburban/rural categorizations. The ethnic breakdown included 80.5% Caucasian, 10.2% Asian American, 5.4% African American, 2.8% Hispanic or Latino, and 3.8% Other. By gender, the breakdown was 51.4% male, 48.6% female.

Procedure/ Materials

Students used the *Astronomy Village* software for an average of 20 instructional periods. Students were given pretest/posttest instruments that measured learning: One instrument measured *Content Understanding*, and the other measured *Problem Solving*.

At pretest time, students also took the Inventory of Metacognitive Self-Regulation (IMSR) which measures five factors related to awareness of learning processes and control of learning strategies: (1) Knowledge Of Cognition, (2) Objectivity (3) Problem Representation, (4) Subtask Monitoring, and (5) Evaluation (Howard, McGee & Shia, 1999). The IMSR includes 32 items that use a five-point Likert scale. For each of the 32 items, students are instructed to circle the answer that best described the way they are when solving problems in math or science class (1=never, 2=seldom/rarely, 3=sometimes, 4=often/frequently, 5=always). The validation of the IMSR and a more detailed explanation of the five factors is discussed elsewhere (Howard, McGee & Shia, 1999).

Results

Our first hypothesis was that each of the five facets of metacognitive self-regulation would predict success at problem solving. Overall, the IMSR total score was a significant predictor of both Content Understanding and Problem Solving ($\beta = .144$, $p=.000$ and $\beta = .176$,

p=.000, respectively). See Table 1 for details. Three of the five factors (Knowledge Of Cognition, Objectivity, & Problem Representation) were significant predictors of Content Understanding. In addition, four of five factors (Knowledge Of Cognition, Objectivity, Problem Representation, & Evaluation) were significant predictors of Problem Solving. See Tables 2 & 3 for details. See Table 4 for an overview of these findings.

Insert Tables 1, 2, 3, & 4 about here

Our second hypothesis was that high levels of metacognitive self-regulation would compensate for low overall aptitude. For aptitude, we used student GPAs converted to *z*-scores for comparison between schools. (In the final version of this paper, we will also include analyses on additional aptitude measures derived from student achievement test scores.) Students were grouped into high and low categories on aptitude and metacognitive self-regulation using the top and bottom 28%. Two 2x2 ANOVAs were conducted (High v. Low Aptitude X High v. Low Metacognitive Self-Regulation). In terms of Content Understanding, there was a significant interaction. Our hypothesis was supported in that those with High Metacognitive Self-Regulation (HM) compensated for Low Aptitude (LA) (LA/HM=HA/HM > HA/LM). In terms of Problem Solving, there was also a significant interaction, supporting our hypothesis (HA/HM > HA/LM = LA/HM> LA/LM). See Tables 5 and 6 for details.

Implications

The research presented here has several implications for researchers and classroom educators alike. Most researchers in the learning sciences agree that metacognition and self-regulation are important predictors of student success in school. The research briefly presented here helps to justify such claims by demonstrating that particular metacognitive self-regulation variables are important for success in both content understanding and problem solving.

The Five Facets of Metacognitive Self-Regulation

The fact that three of the metacognitive self-regulation variables (Knowledge Of Cognition, Objectivity, & Problem Representation) were related to content understanding has important implications for theory related to self-regulated learning. First, our results indicate that Knowledge of Cognition is related to Content Understanding—a finding which has heretofore not been reported. Secondly, our results add credence to the construct validity of Objectivity & Problem Representation as important self-regulatory variables. We recommend that these variables should be more widely subjected to academic or experimental scrutiny to confirm their importance. The fact that the two facets (Subtask Monitoring and Evaluation) were not predictors of Content Understanding is in line with prior research indicating that certain regulatory variables are only moderately correlated with domain knowledge if at all. That is, lower-level learning may not require high degrees of self-regulation.

Knowledge Of Cognition, Objectivity, Problem Representation, & Evaluation were significant predictors of Problem Solving. . In retrospect, we realize that the one non-significant variable, Subtask Monitoring, may not have been important for either Content Understanding or Problem Solving because the software accomplishes such tasks for the learner. That is, the program breaks down problems into manageable chunks and helps students to monitor and evaluate completion of those chunks. In terms of the Evaluation factor, we believe it was a significant predictor for Problem Solving (but not for Content Understanding) because evaluation serves the learner by helping to organize content knowledge and thus solve problems more efficiently. This finding is in line with our prior research which demonstrated that well-

BEST COPY AVAILABLE

organized knowledge helps students to apply their content understanding in solving novel science problems (Hong, McGee & Howard, 1999).

Metacognitive Self-Regulation v. Aptitude

Swanson's (1990) research has been heralded as a pivot point for research in metacognition and problem solving, and is oft-cited in discussions regarding the importance of metacognition. The research reported here provides an important confirmation of Swanson's findings and extends it into two new areas. In terms of confirming Swanson's (1990) work, we found congruent results: high levels of metacognitive self-regulation compensated for low overall aptitude (in regards to problem solving). In terms of extending Swanson's (1990) work--first, we provide evidence that content understanding is as much a factor of metacognitive self-regulation as it is of aptitude. To our knowledge, no prior research has demonstrated such an outcome. Second, in our work, we were able to use a short self-report measure for metacognitive self-regulation that provided results comparable to the measures Swanson used which required think-aloud protocols and extensive coding schemes.

References

Artzt, A. F., & Armour-Thomas, E. (1992). Development of a cognitive-metacognitive framework for protocol analysis of mathematical problem solving in small groups. Cognition and Instruction, 9, 137–175.

Audet, R. H., Hickman, P., & Dobrynina, G. (1996). Learning logs: A classroom practice for enhancing scientific sense making. Journal of Research in Science Teaching, 33(2), 205–222.

Bruning, R. H., Schraw, G. J., & Ronning, R. R. (1995). Cognitive psychology & instruction. Englewood Cliffs, NJ: Merril.

Carr, M., & Jessup, D. L. (1997). Gender differences in first-grade mathematics strategy mathematics strategy use: Social and metacognitive influences. Journal of Educational Psychology, 89(2), 318–328.

Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. Cognitive Science, 13, 145–182.

Davis, E. A. (1998). Reflection prompts in the knowledge integration environment. Paper presented at the annual American Educational Research Association, San Diego, CA.

Hmelo, C. E., & Cote, N. C. (1996). The development of self-directed learning strategies in problem-based learning. In D. C. Edelson & E. A. Domeshek (Eds.), Proceedings of the International Conference of the Learning Sciences Evansdale, IL: Association for the Advancement of Computing in Education.

Hong, N. (1998). The relationship between well-structured and ill-structured problem solving in multimedia simulation. Unpublished doctoral dissertation, Pennsylvania State University, State College, PA.

Howard, B. C., McGee, S., & Shia, R. (1999). Metacognitive self-regulation and problem solving: Expanding the theory base through factor analysis. (Available: http://www.cotf.edu/research.html). Wheeling, WV: NASA Classroom of the Future.

King, A. (1988). Verbal interaction in computer-assisted cooperative problem-solving groups. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

King, A. (1994). Guiding knowledge construction in the classroom: Effects of teaching children how to question and how to explain. American Educational Research Journal, 31(2), 338–368.

Linn, M. C. (1995). Designing computer learning environments for engineering and computer science: The scaffolded knowledge integration framework. Journal of Science Education and Technology, 4(2), 103–126.

Pressley, M., Schuder, T., Bergman, J. L., & El-Dinary, P. B. (1992). A research-educator collaborative interview of transactional comprehension strategies instruction. Journal of Educational Psychology, 84(2), 231–246.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. The Journal of the Learning Sciences, 1, 37–68.

Swanson, H. L. (1990). Influence of metacognitive knowledge and aptitude on problem solving. Journal of Educational Psychology, 82(2), 306–314.

Thomas, J. W., & Rohwer, W. D. (1986). Academic studying: The role of learning strategies. Educational Psychologist, 21, 19–41.

Tobias, S., & Everson, H. T. (1995, April). Development and validation of an objectively scored measure of metacognition appropriate for group administration. Paper presented at the annual convention of the American Educational Research Association, San Francisco, CA.

BEST COPY AVAILABLE

White, B. Y., & Frederiksen, J. R. (1995). The ThinkerTools inquiry project: Making scientific inquiry accessible to students and teachers (Causal Models Research Group Report CM-95-02). Berkeley, CA: University of California at Berkeley, School of Education.

White, B. Y., & Frederiksen, J. R. (1998). Inquiry, modeling, and metacognition: Making science accessible to all students. Cognition and Instruction, 16, 3–118.

Zimmerman, B. J. (1989). Models of self-regulated learning and academic achievement. In B. Zimmerman & D. Schunk (Eds.) Self-regulated learning and academic achievement: Theory, research, and practice (pp. 1–25). New York: Springer-Verlag.

Table 1

Summary of Simultaneous Regression Analyses: IMSR Total as a predictor of Content Understanding and Problem Solving (N=829)

Variables	B	SE B	ß	T	Sig. T
Content Understanding	.11	.02	.14	4.96	.000
Constant	4.85	.40		12.24	.000
Problem Solving	.19	.03	.18	6.09	.000
Constant	4.12	.56		7.38	.000

Table 2

Summary of Simultaneous Regression Analysis: IMSR Factors as Predictors of Content Understanding (N=820)

Variables	B	SE B	ß	T	Sig. T
Knowledge of Cognition	.48	.18	.13	2.72	.007
Problem Representation	.46	.15	.15	2.98	.003
Subtask Monitoring	.15	.17	.05	.92	.360
Evaluation	.10	.14	.03	.70	.481
Objectivity	-.56	.14	-.19	-4.01	.000
Constant	4.16	.47		8.92	.000

Note. R^2= ..07; adj. R^2=. 06

Table 3

Summary of Simultaneous Regression Analysis: IMSR Factors as Predictors of Problem Solving (N=820)

Variables	B	SE B	ß	T	Sig. T
Knowledge of Cognition	.61	.24	.12	2.55	.011
Problem Representation	.90	.21	.22	4.38	.000
Subtask Monitoring	.09	.23	.02	.40	.689
Evaluation	.42	.19	.11	2.21	.027
Objectivity	-.95	.18	-.23	-5.18	.000
Constant	3.20	.64		5.03	.000

Note. R^2= .10; adj. R^2=.10

Table 4

BEST COPY AVAILABLE

Which Facets of Metacognitive Self-Regulation Are Significant Predictors of Content Understanding And Problem Solving

	Content Understanding	Problem Solving
Knowledge of Cognition: how much learners understand about the extent and utilization of their unique cognitive abilities and the ways they learn best	*	*
Objectivity: standing outside oneself and thinking about one's learning as it proceeds	*	*
Problem Representation: understanding the problem fully before proceeding	*	*
Subtask Monitoring: breaking the problem down into subtasks and monitoring the completion of each subtask		
Evaluation: double-checking throughout the entire problem-solving process to evaluate if it is being done correctly		*

Table 5
Content Understanding

		High Metacognitive Self-Regulation	Low Metacognitive Self-Regulation
		HA/HM	HA/LM
High Aptitude	*Mean*	7.84	7.15
	SD	1.79	2.59
		LA/HM	LA/LM
Low Aptitude	*Mean*	6.30	5.94
	SD	2.20	2.42

HA/HM > HA/LM, p=.001
HA/HM > LA/LM, p=.000
LA/HM > LA/LM, p=.002

Table 6
Problem Solving

		High Metacognitive Self-Regulation	Low Metacognitive Self-Regulation
		HA/HM	HA/LM
High Aptitude	*Mean*	9.46	8.19
	SD	2.95	3.06
		LA/HM	LA/LM
Low Aptitude	*Mean*	7.26	6.05
	SD	2.94	2.79

HA/LM > LA/LM, p=.000
LA/HM > LA/LM, p=.050
HA/HM > LA/LM, p=.000
HA/HM > HA/LM, p=.015
HA/HM > LA/HM, p=.000

BEST COPY AVAILABLE

How do You Solve Problems?

Please read the following sentences and circle the answer that best describes the way you are when you are trying to solve a problem. Think about a problem that you might see in a science or math class.

- Think about when you have to solve a hard problem. What do you do before you start?
- What do you do while you work the problem?
- What do you do after you finish working the problem?

There are no right answers--please describe yourself as you are, not how you want to be or think you ought to be. Your teacher will not grade this.

Never	Seldom/ Rarely	Sometimes	Often/ Frequently	Always
A	B	C	D	E

1. I try to understand what the problem is asking me.	A B C D E
2. I think of several ways to solve a problem and then choose the best one.	A B C D E
3. I look back at the problem to see if my answer makes sense.	A B C D E
4. I use different ways to memorize things.	A B C D E
5. I think to myself, do I understand what the problem is asking me?	A B C D E
6. I read the problem more than once.	A B C D E
7. I think about what information I need to solve this problem.	A B C D E
8. I use different learning strategies depending on the problem.	A B C D E
9. I look back to see if I did the correct procedures.	A B C D E
10. I think about how well I am learning when I work a difficult problem.	A B C D E
11. I use different ways of learning depending on the problem.	A B C D E
12. I go back and check my work.	A B C D E
13. I read the problem over and over until I understand it..	A B C D E
14. For this question, please circle letter B.	A B C D E
15. I check to see if my calculations are correct.	A B C D E
16. When it comes to learning, I can make myself learn when I need to.	A B C D E

Never A	Seldom/ Rarely B	Sometimes C	Often/ Frequently D	Always E

17. I ask myself how well I am doing while I am learning something new.	A B C D E
18. I check my work all the way through the problem.	A B C D E
19. I identify all the important parts of the problem.	A B C D E
20. I try to understand the problem so I know what to do.	A B C D E
21. I think about all the steps as I work the problem.	A B C D E
22. I can make myself memorize something.	A B C D E
23. When it comes to learning, I know my strengths and weaknesses.	A B C D E
24. I pick out the steps I need to do this problem.	A B C D E
25. When I am done with my schoolwork, I ask myself if I learned what I wanted to learn.	A B C D E
26. I double-check to make sure I did it right.	A B C D E
27. For this question, please circle letter A.	A B C D E
28. I try to break down the problem to just the necessary information.	A B C D E
29. I use learning strategies without thinking.	A B C D E
30. When it comes to learning, I know how I learn best.	A B C D E
31. I ask myself if there are certain goals I want to accomplish.	A B C D E
32. I try more than one way to learn something.	A B C D E

The Inventory of Metacognitive Self-Regulation ©. Copyright 1998-2000 by Wheeling Jesuit University/ Center for Educational Technologies. All rights reserved.

First presented in Howard, B. C., McGee, S., Shia, R., & Hong, N. S. (2000, April). *Metacognitive Self-Regulation and Problem-Solving: Expanding the Theory Base Through Factor Analysis*. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

BEST COPY AVAILABLE

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

TM034600

I. DOCUMENT IDENTIFICATION:

Title: The Influence of Metacognitive Self-Regulation on Problem-Solving in Computer-Based Science Inquiry	
Author(s): Bruce C. Howard, Steven McGee, Namsoo S. Hong, Regina Shia	
Corporate Source: Wheeling Jesuit University/Center for Educational Technologies	Publication Date: AERA 2000

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Level 1

☒

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) and paper copy.

The sample sticker shown below will be affixed to all Level 2A documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Level 2A

☐

Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only

The sample sticker shown below will be affixed to all Level 2B documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

Level 2B

☐

Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, → please

Signature:		Printed Name/Position/Title: Dr. Bruce Howard – Curriculum Director	
Organization/Address: Wheeling Jesuit University/CET 316 Washington Ave Wheeling, WV 26003		Telephone: 304-243-4308	FAX: 304-243-2497
		E-Mail Address: research@cet.edu	Date: 10/30/02

(Over)

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

ERIC CLEARINGHOUSE ON ASSESSMENT AND EVALUATION
UNIVERSITY OF MARYLAND
1129 SHRIVER LAB
COLLEGE PARK, MD 20742-5701
ATTN: ACQUISITIONS

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706

Telephone: 301-552-4200
Toll Free: 800-799-3742
FAX: 301-552-4700
e-mail: info@ericfac.piccard.csc.com
WWW: http://ericfacility.org

EFF-088 (Rev. 2/2001)